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ABSTRACT

This study examined the factors affecting the four-year academic performance and outcomes of 1,249 underprepared students at Prince George's Community College (Maryland). The fall 1994 freshmen required remediation in reading, writing, or mathematics. Subjects were defined as achievers if, by summer 1998, they had earned a degree or certificate from the college, transferred to a senior college, or earned at least 30 credits. All remaining subjects were regarded as nonachievers. End of semester records for all students were reviewed for relevant information. The study used Astin's input-environment-outcome model and conducted logistic regression analysis on 30 possible predictors with academic outcomes as the dependent variable. One input variable and five environment variables entered the final model as a result of forward stepwise selection. These six significant predictors of these students' academic outcomes were: cumulative credit hours earned; good academic standing; cumulative grade point average; course load; the number of developmental courses taken; and race/ethnicity. (Contains 14 references.) (DB)

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Factors Affecting Academic Outcomes Of Underprepared Community College Students

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Factors Affecting Academic Outcomes Of Underprepared Community College Students

Abstract

In order to identify the factors affecting the academic achievement of underprepared students, the institutional research office at Prince George's Community College recently investigated the four-year academic performance and outcomes of those fall 1994 freshmen who required remediation in reading, writing, or mathematics (N=1,249). Designed under Astin's input-environment-outcome model, this study involved a logistic regression analysis of 30 possible predictors with academic outcomes as the dependent variable. One input variable and five environment variables entered the final model as a result of forward stepwise selection. This paper includes a literature review and discusses the implications of the research findings.

Factors Affecting Academic Outcomes Of Underprepared Community College Students

Introduction

Underprepared college students are students with basic deficiencies in academic skills necessary for the satisfactory completion of college-level course work. As a major academic support mechanism, developmental education provided for such students has long become an important component of instructional activities at many American colleges and universities. This is especially so with public two-year institutions, where 41% of the freshmen enrolled in developmental courses nationwide in fall 1995 (USDE, 1996b). At Maryland community colleges, this figure reached almost 60% during the 1994-1995 academic year (Maryland Higher Education Commission, 1996). Given the diminishing resources for higher education in the recent decades, the increasing demand for developmental education has evoked a controversy as to whether or not colleges and universities should end or limit remediation after high school (Ignash, 1997). While this debate may well continue into the next millennium, institutional researchers at community colleges can at least be certain of one thing right now: With the expected 16% enrollment increase in higher education over the next ten years (USDE, 1996a) as well as the open-admissions policies of community colleges, the underprepared student population on our campuses is most likely to increase in the foreseeable future, and institutional researchers will more frequently find themselves involved in the evaluation of developmental education programs in response to accountability demands.

Prince George's Community College (PGCC) is a comprehensive community college in Prince George's County, Maryland, which enrolls approximately 12,000 credit students each fall

and spring semester. Reflecting the demographic characteristics of the county, some 70% of our students are African American. To ensure that our new entrants are fully prepared for college studies, they are required to demonstrate their basic academic skill proficiencies in reading, writing, and mathematics when seeking credit course enrollment for the first time. Students can do this either through placement testing or through developmental course completion. Past records indicate that the percentage of underprepared students identified by placement testing has been consistently high. The Office of Institutional Research and Analysis (OIRA) at the college conducted a research in 1995 to investigate the four-year academic outcomes of the underprepared students in the fall 1990 freshmen cohort. The findings of the research subsequently helped the college administration take new initiatives to improve the academic progress rates of these students. In summer 1998, a research project was carried out at OIRA to revisit the issue of underprepared students' academic outcomes. By taking the academically deficient students in the fall 1994 freshmen cohort as a sample, this study was expected to identify the factors affecting their academic achievement so that measures could be taken to help these students really benefit from the democratic access to higher education in this nation.

Literature Review

Astin's (1991, 1996) input-environment-outcome (I-E-O) model has provided an important conceptual framework for studying academic outcomes in higher education. In his terminology, inputs refer to the personal characteristics the student initially brings to the institution, including the level of talent the individual previously developed. Environment refers to the student's actual educational and non-educational experiences at the institution that are associated with various programs, policies, faculty and peers. Outcomes refer to the talents that the institution seeks to cultivate in the student. By focusing on the change or growth in the

student after being exposed to the environment, this model enables the faculty and administration to find the type of environmental conditions that may best facilitate the development of student talents.

A presentation of academic assessment theories will be incomplete without the mention of models for studying student retention, mainly because these models invariably include academic outcomes as an important intervening construct affecting the student's decision to persist or not. Tinto's (1975, 1987) attrition model is probably the most popular theoretical framework whenever student retention becomes of research interest. In Tinto's view, the student enters the institution with a spectrum of background attributes and high school experiences that lead to the individual's educational goals and initial commitment to the institution. Together, these factors influence the way the student interacts with, and gradually integrates into the academic and social systems of the institution. The degree of academic integration and social integration in turn changes the student's initial commitment to the institution, which eventually makes the individual persist or exit from the college. Largely based on the notion of person-environment fit, Tinto's model is especially helpful in locating problems in the interwoven systems of student retention.

Considering the unique characteristics of the growing number of nontraditional students on college campuses in recent decades, Bean and Metzner (1985) proposed a new student attrition model to explain the withdrawal decisions of these older part-time commuter students. Partly derived from Tinto's (1975) traditional student attrition model, Bean and Metzner's model states that the phenomenon of nontraditional student attrition can be accounted for by four sets of variables: the individual's poor academic performance, intent to leave as a function of psychological outcomes and academic variables, background and defining variables, and environmental variables. Noticeably, the two researchers omitted social integration as a primary

component of the model based on the empirical data, and acknowledged the compensatory impact of environmental factors for the negative influence of the academic variables. Apparently, Bean and Metzner's model can better address the student retention issue at community colleges than Tinto's model.

In the last ten years or so, a considerable number of studies have been carried out by individual institutions or government agencies to assess the academic outcomes of underprepared community college students (e.g., Haeuser, 1993; Maryland Higher Education Commission, 1996; Schoenecker, Bollman, & Evens,1996; Seybert & Soltz, 1992; Sinclair Community College, 1995). While most of these studies were descriptive in nature, there emerged some inferential statistics-based research projects that utilized recognized outcomes assessment and student attrition models to varying degrees.

Long and Amey (1993) applied Astin's (1991) I-E-O model to the study of student success with a sample of underprepared students at Johnson County Community College in Kansas. Using a one-way multivariate analysis of variance (MANOVA) with a follow-up discriminant analysis, the two researchers were able to identify two input variables (reading scores and reading placement level, and high school GPA), one environmental variable (number of first term credit hours), and two output variables (highest developmental English course completed and nondevelopmental GPA) that could best distinguish the successful and unsuccessful groups of these underprepared students.

In another example of the application of Astin's (1991) I-E-O model, Campbell and Blakey (1996) assessed the impact of early remediation on the persistence and/or performance of underprepared students at a midwestern, suburban community college. Results of a multiple regression analysis indicated that cumulative GPA, number of remedial courses, early remediation,

first year remedial course taking, and a degree-seeking intent all significantly impacted student persistence. It was also revealed that age, ethnicity, gender, and a degree-seeking intent were significant predictors of the academic performance of underprepared students.

At PGCC, Boughan (1995) conducted a comprehensive analysis of the developmental placement and academic progress issue by tracking underprepared students in the fall 1990 entering cohort. In a related study, Boughan and Clagett (1995) examined the four-year academic achievement of the whole cohort by means of logistic regression analysis. Although not explicitly model-based, they incorporated into their research design previous findings in the model-based outcomes assessment literature. Findings from this study suggested that significant predictors of academic achievement of degree-seeking students, prepared and underprepared alike, included cumulative GPA, summer session attendance, curriculum change, good academic standing, average credit hour load, remediation completion, first-year average credit hour load, developmental course taking, no curriculum choice, first-year good academic standing, immediate entry from high school, enrollment in hi-tech or allied health programs, and under 21 years of age. In the sequel, Boughan (1997) used path analysis to model the academic performance of community college students, and effectively verified the findings from the Boughan and Clagett (1995) study.

An inspection of the literature on the academic outcomes of underprepared community college students shows that cumulative GPA is probably the best predictor of the academic success of these students. It also shows that, despite the apparent theoretical and empirical gains from model-, and inferential statistics-based studies, such research endeavors are still insufficient in number, if we take into consideration the mere size of the target student population nationwide whose academic pursuits might be facilitated by the policy changes at their institutions resulting

from the findings of our studies. Therefore, for both our better understanding of the factors affecting academic outcomes of these students and any potential improvement we can bring to developmental education programs, institutional researchers at public two-year colleges should devote more time and effort to the study of this assessment issue.

Method

Subjects

The subjects for this study (N = 1,249) included all the fall 1994 degree-seeking first-time entrants at PGCC who took the placement testing, and were identified as academically deficient in at least one of the three areas: reading, writing, and mathematics. Following the PGCC student outcomes typology as presented in Boughan and Clagett (1995), subjects were defined as achievers if they had earned a degree or certificate from the college, or transferred to a senior college, or earned at least 30 credits with a cumulative GPA of 2.0 or above by the end of summer session 1, 1998. The remaining subjects, whether they still enrolled at the college in spring 1998 or not, were all regarded as nonachievers. To assess their academic performance and outcomes between their first semester and summer session 1, 1998, the end-of-semester student records maintained by the college information systems for the corresponding semesters were reviewed, and the relevant information was extracted.

Research Design and Data Analysis

This study was designed under Astin's (1991, 1996) I-E-O model. Although this model explored the three relationships among the model components: inputs and environment, environment and outputs, and inputs and outputs, the relationship between inputs and environment was not examined in the study for its lack of immediate research interest. To answer the research question as to whether there existed a nonlinear combination of input and

environmental variables that could effectively determine the binary outcome status of the subjects, logistic regression analysis with likelihood-ratio-based forward stepwise selection was employed as the major statistical method for the study. SPSS for Windows Release 8.0 (SPSS Inc., 1998) was used for the analysis, which involved a total of 31 variables based on the literature on outcomes assessment and student attrition, with academic outcomes as the dependent variable. Table 1 summarizes the relevant information of these variables. There were 15% of missing values with the variable B90. They were replaced with their estimates by employing the linear trend at point method as implemented in SPSS.

Results

A crosstabulation of the demographic characteristics of the fall 1994 underprepared PGCC students indicates that this group of students were mainly female, nonwhite, and under twenty years of age (see Table 2). The average subgroup achievement rates of various demographic classifications was 17%, with 13% (male) and 23% (white) at the two extremes.

The likelihood-ratio-based forward stepwise variable selection terminated at step 6 in the logistic regression analysis when no more variables met entry or removal criteria. Table 3 provides descriptive statistics of the five environmental variables in the final model. (RACE is excluded from the table for its binary nature.)

Although the diagnostic statistics revealed a few unusually large residuals and influential cases, the goodness of fit of the regression model was satisfactory. Table 4 indicates that this model had an overall 95% correct prediction rate. Table 5 presents the change in -2LL statistic from the initial model containing the constant only before the first step to the final model after the last step. As another measure of how well the estimated model fits the data, -2LL is the product of -2 times the log of the likelihood, with the value of 0 for a perfect match. The decrease of its

Table 1. Name and Type of Variables for Logistic Regression Analysis

Input variables
AGE: Age (Continuous)
GENDER: Gender (Binary, male = 0, female = 1)
RACE: Race/ethnicity (Binary, white = 0, nonwhite = 1)
HSTYPE: High school type (Ordinal, PG private school = 1, elite PG public school = 2, other PG public school = 3, other school = 4)
B90: Social economic status (Ordinal, a 15-category scale based on Boughan & Diehl (1995))
ENTDLAY: Delayed entry (Continuous)
DVE944: Dev. English required (Binary, yes = 1, no = 0)
DVM944: Dev. math required (Binary, yes = 1, no = 0)
MPLUS: Dev. math and another develop. area required (Binary, yes = 1, no = 0)
DVR944: Dev. reading required (Binary, yes = 1, no = 0)
EFL944: English as a foreign language required (Binary, yes = 1, no = 0)
DVTOTL: Number of dev. areas required (Continuous)
Environmental variables
CURCH: Percent. of semesters with curriculum change (Continuous)
GOALCH: Percent. of semesters with attendance goal change (Continuous)
REASONCH: Percent. of semesters with attendance reason change (Continuous)
TERM: Number of semesters attended (Continuous)
MJ3TERM: Number of first three major semesters attended (Continuous)
SMTERM: Number of summer semesters attended (Continuous)
LOADMJ: Average major semester credit hour load (Continuous)
SITES: Percent. of semesters with combined attendance locations (Continuous)
SCHS: Percent. of semesters with combined attendance schedules (Continuous)
CDY1: Cumulative first-year credit hours earned (Continuous)
CDEN: Cumulative credit hours earned (Continuous)
GPA: Cumulative GPA (Continuous)
DISPG: Percent. of semesters with good academic standing (Continuous)
DVCRS944: Number of dev. courses taken in fall 1994 (Continuous)
DVCRS: Number of dev. courses taken since fall 1994 (Continuous)
DVGDPP: Percent. of dev. courses taken with passing grade (Continuous)
DVCOMP: Number of dev. areas completed (Continuous)
FAID: Percent. of semesters with financial aid (Continuous)
Outcome Variable
OUTCM: Academic outcomes (Binary, achiever = 1, nonachiever = 0)

Table 2. Demographic Characteristics of Fall 1994 Underprepared Students By Academic Outcomes (N = 1,249)

Demographic Characteristics		Academic outcomes		Subtotal
		Achiever	Non-achiever	
Gender	Male	63	409	472
	Female	145	632	777
Race/ Ethnicity	White	47	159	206
	Nonwhite	161	882	1,043
Age	Under 20	140	632	772
	20 - 24	32	202	234
	25 +	36	207	243

Table 3. Descriptive Statistics of Selected Environmental Variables (N = 1,249)

Variable name	M	SD
LOADMJ	8.7	3.2
CDEN	16.8	19.8
GPA	1.6	1.2
DISPG	.6	.4
DVCRS	2.0	1.8

Table 4. Classification Table for OUTCM

Observed	Predicted		Percent Correct
	Yes	No	
Yes	168	40	81%
No	23	1,018	98%
	Overall		95%

value from 1124.97 before the first step to 331.22 after the last step should be regarded as a significant improvement. The difference between the two -2LL values is listed in Table 5 as the model chi-square, and the step chi-square in the same table represents the change between the last two steps of variable selection. For these two chi-squares, their degrees of freedom (df) and significance levels (Sig) are also presented.

Table 5. Goodness of Fit for the Regression Model

Name	Value	df	Sig.
-2 LL before step 1	1124.97		
-2LL after step 6	331.22		
Goodness of Fit	992.61		
Model Chi-square	793.74	6	.00
Step Chi-square	5.78	1	.02

Table 6 displays the parameter estimates for the six variables in the final model and their related statistics. They include the estimated regression coefficients (B) and standard errors (SE), the Wald statistics for testing hypotheses about the coefficients (Wald) and degrees of freedom (df) and significance levels (Sig), the R statistics for measuring the partial correlation between the dependent variable and each of the independent variables, and the odds of an event occurring (Exp(B)). Of the six significant predictors of the academic outcomes of the underprepared students, CDEN (R = .35) and GPA (R = .17) were more closely related to the dependent variable OUTCM, and DISPG (Exp(B) = 19.47) could change the odds of becoming an achiever most dramatically. Two predictors DVCRS and RACE (1) each carried a negative coefficient, indicating that both the number of developmental courses taken and the racial/ethnic status had a negative relationship with the academic outcomes.

Table 6. Parameter Estimates for the Regression Model

Variable	B	SE	Wald	df	Sig	R	Exp(B)
CDEN	0.15	0.01	135.95	1	.00	.35	1.16
DISPG	2.97	1.11	7.17	1	.01	.07	19.47
GPA	1.60	0.28	32.94	1	.00	.17	4.94
LOADMJ	0.20	0.06	13.01	1	.00	.10	1.23
DVCRS	-0.19	0.08	5.50	1	.02	-.06	0.83
RACE (1)	-1.28	0.42	9.43	1	.00	-.08	0.28
Constant	-13.45	1.46	85.11	1	.00		

Discussion

The results of the logistic regression analysis verified some findings of previous research that cumulative credit hours earned, good academic standing, cumulative GPA, course load, the number of developmental courses taken, and race/ethnicity have varying degrees of impact on the academic progress of underprepared community college students (Boughan & Clagett, 1995; Campbell & Blakey, 1996; Long & Amey, 1993). As most of the variables included in the final logistic regression model reflected the environmental experiences of college students in general, some people may suggest that this model may not well explain the academic outcomes of underprepared community college students. This, however, may not be true. First, whether students are prepared or underprepared for college-level course work, the outcomes of their academic endeavors bear some common characteristics that are traditionally evaluated with measures such as course load, GPA, and academic standing. Second, with increasingly vigorous enforcement of mandatory placement in developmental education courses, the mere attainment of some GPA points and credit hours marks an underprepared student's upward movement from developmental courses to college-level courses, since developmental courses usually do not carry credit toward a certificate or a degree. There was some obvious cohesion among four out of the

six predictors in the logistic regression model: With an adequate course load in major semesters (LOADMJ), an underprepared student was expected to earn more credit hours (CDEN); as the number of credit hours grew almost simultaneously with the individual's academic level, the student was more likely to have a higher GPA and to remain in good academic standing (DISPG). There was one environmental predictor (DDVCRS) in the model that directly measured the effect of developmental education. The regression coefficient was negative because the number of developmental courses taken since fall 994, whether conscientiously or not, reflected the severity of the student's academic deficiencies. As the only input variable in the logistic regression model, RACE was negatively related to academic outcomes as well. Since nonwhite students were coded as 1 for this data analysis, it could be inferred that these students did not fare as well as their white peers in developmental education, and subsequent college-level education programs.

Given the apparent scarcity of input variables in the final logistic regression model, it might be argued that Astin's (1991, 1996) I-E-O model was not fully supported by this study. Yet this could be an artifact of the practical constraints that limited the way the data were collected for the study. For example, the two variables HSTYPE and B90, were both useful input variables. However, since these measures were based on groups (i.e., schools and communities) rather than on individual persons, the within-group variability of these variables became unavoidably blurred. Also, our research office relies on the Transfer Student System of Maryland Higher Education Commission for transfer student information. Yet this system can only identify PGCC students who transferred to a Maryland four-year public post-secondary institution with at least 12 credits about a year ago. As a result, some "dropouts" in our student data base with high GPAs might be real achievers who may have long transferred to a private institution or an out-of-state institution. There were other factors that may have affected the results of this study.

Because of the limited resources, we were not able to conduct a comprehensive model-based student survey to collect data. Besides, our selection of only underprepared students as the target of our research might methodologically nullify the use of some developmental education-related variables in our analysis.

Conclusion

A recent logistic regression analysis of the longitudinal data of the underprepared students in the fall 1994 PGCC new entrants identified six significant predictors of these students' academic outcomes. As the predictors were largely academic, it seems that the underprepared students should be encouraged to work harder, and to persist at the college. The current academic achievement rate of PGCC underprepared students is low. However, with our devoted faculty, administration, and Educational Development Program personnel, the situation is improving. The college will continue to enroll a large number of underprepared students, yet it will never become a remedial education institution (Bickford, Clagett, James, & Taibi, 1998).

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